J10 Discrimination of Document Paper by Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS)

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After attending this presentation, attendees will have gained an appreciation of the strong potential of LA ICPMS for forensic paper investigations.

This presentation will impact the forensic community and/or humanity by demonstrating how LA ICPMS is a very discriminating technique for forensic paper investigations and therefore can provide important forensic evidence especially in cases involving anonymous letters, the counterfeit manufacture of paper banknotes, and document fraud. The technique is used for forensic investigations into threat letters and terrorism related incidents.

The discrimination between sheets of document paper can provide important forensic evidence, especially in cases involving anonymous letters, the counterfeit manufacture of paper banknotes and document fraud. Historically paper characterization has relied upon the measurement of gross physical properties such as strength, thickness, mass per unit area or the measurement of fiber content, color, and fluorescence. However, the problem with using these methods for the characterization of paper remains the inability to match two sheets of paper with a high degree of certainty.

In this work a detailed evaluation of Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS) for discriminating document paper is presented. Using LA-ICP-MS an elemental profile can be measured of both major and trace elements present in the paper. It will be shown that these elemental profiles are highly characteristic for the origin of the paper.

Inductively coupled plasma mass spectrometry (ICP-MS) has been applied to many types of material that are commonly encountered in forensic investigations, such as plastics, tape, bullet alloys, and glass but until relatively recently it had not been applied to paper. Spence and others[1] have employed solution nebulization ICP-MS for the characterization of document paper. The discrimination of papers from different sources was attempted by virtue of their elemental compositions. Nine elements were found to be suitable discriminators because of their high concentrations. The results showed that elemental analysis using ICP-MS provides an effective and robust technique for the discrimination of document paper. In this study the authors will focus on the possibilities of LA-ICP-MS. Compared to solution nebulization ICP-MS it offers several advantages such as speed and a smaller required sample size. In the same analysis also printed ink can be analyzed.

The discriminating power of LA-ICP-MS was evaluated by analyzing 25 different paper types from the European market. From two paper types also several paper batches were measured. A small piece of paper was cut out from the sheet and put into the ablation chamber. The paper is subsequently ablated using a 213 nm Nd:YAG laser with a spot size of 140 µm and a line-scan of 5000 µm. The ablated material is swept into an Elan 6100 ICP-MS which uses an element program of 45 elements. The time dependent signal from the line scan is integrated. In the comparisons of document papers net element intensities are used that are normalized relative to the intensity of strontium. Multivariate statistical techniques such as cluster analysis, principal component analysis (PCA) and discriminant analysis (DA) were used to establish the discriminating power.

LA-ICP-MS provides full discrimination of at least 23 out of the 25 paper types. Several casework examples (document paper, banknotes, envelopes) will be discussed to demonstrate the value of LA-ICP-MS in forensic paper analysis.

[1] Spence L.D., Baker A.T. and Byrne J.P., J. Anal. At. Spectrom., 2000, 15, 813-819.

ICPMS, Document, Paper

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